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Inducing States of Consciousness with a Binaural Beat Technology

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Abstract — Altering consciousness to provide a wide range of beneficial effects (stress-reducing relaxation, improved sleep, intuitive, creative, meditative, healing, and expanded-learning states, etc.) necessarily involves either changing levels of arousal or cognitive content or both. The *extended reticular-thalamic activating system* model suggests a neural mechanism responsible for regulating generalized levels of arousal (basic rest-activity cycle, sleep cycles, ultradian rhythms, etc.) as well as behavior- or cognition-specific patterns of arousal. The cortical attributes or contents of consciousness are the result of social-psychological conditioning and elemental cognitive acuity. These ambient factors of consciousness (arousal and content) provide us with a *first-person* experience or awareness. Effective induction of propitious states of consciousness, therefore, requires a multidimensional approach involving sensory-information stimuli, social-psychological conditioning, and education. Binaural beating, a sensory-information stimulus, provides potential consciousness-altering *information* to the reticular-thalamic activating system which in turn alters arousal states, attentional focus, and level of awareness (crucial elements of consciousness itself). Integrated with other sensory-information techniques, social-psychological conditioning tools, and educational curriculum, binaural beats can provide access to a variety of beneficial applications and first-person experiences of expanded states of consciousness.

Introduction

States of consciousness form as a synthesis of discrete, yet cortically distributed, levels of arousal combined with specific contents. The extended reticular-thalamic activating system (ERTAS) is responsible for regulating generalized levels of arousal as well as individual explicit patterns of arousal (Newman 1997). The specific contents of consciousness are said to be neurologically *cortical*. These cortical attributes are the result of social-psychological conditioning and elemental cognitive acuity. Effective induction of propitious altered states of consciousness requires, therefore, a multidimensional approach involving sensory-information stimuli, social-psychological conditioning, and education. Chief among the sensory-information techniques for inducing beneficial altered states is the procedure of placing an individual into an

environment of greatly reduced stimulation for brief periods (less than 2 hours). The two most frequently used methods are lying on a bed in a dark, soundproof room and flotation (dry or wet) in a buoyant liquid at skin temperature in a light-free, soundproof chamber (Turner & Fine 1985). The *ganzfeld* technique is another effective sensory-information method to induce advantageous altered states of consciousness (Hutchinson 1986). During these periods of restricted sensory impetus the ERTAS is particularly vulnerable to other stimuli. Sensory information such as aroma, color, music, touch, and binaural beating can all serve to further direct changes in consciousness via cortico-thalamic adaptation. Because consciousness is a synthesis of both arousal and content, altered states of consciousness can be further inspired by changes in a percipient's social-psychological conditioning and cognitive skills. Social-psychological conditioning tools can modify attitude, expectancy, motivation, etc., and educational approaches can expand cognitive skills.

The sensory-stimulus known as binaural beating can be effective in inducing altered states of consciousness when used in conjunction with a multidimensional process of social-psychological conditioning and education. Individuals in an environment of restricted stimulation listen to a combination of multiplexed audio binaural beats that are mixed with music, pink sound, and/or assorted natural sounds. Pink sound is "white noise" (like the hiss sound from a television after a station has stopped transmitting) equalized for human hearing with lower-frequency components amplified and higher-frequency components reduced to create a more pleasing natural sound. Binaural-beat stimulation, coupled with the effects of the other procedures within the process outlined above, appears to regulate arousal states and encourage first-person experiences in altered states of consciousness by providing *information* to the ERTAS.

Binaural Beats and The Physiology of the Brain

Binaural beating is associated with an electoencephalographic (EEG) frequency-following response in the brain that has been demonstrated by Oster (1973) and in the context of hearing-acuity research (Hink et al. 1980). Many other studies have demonstrated the presence of a frequency-following response to auditory stimuli, recorded at the vertex of the human brain (top of the head). This EEG activity was termed "frequency-following response" because its period (cycles per second) corresponds to the fundamental frequency of the stimulus (Smith, Marsh, & Brown 1975). Stated plainly, if the audio stimulus is 24 Hz the resulting measured EEG will show a 24 Hz frequency-following response using appropriate time-domain averaging protocols. This frequency-following response signal is, however, very small and represents only a small portion of the overall EEG and is not, in and of itself, representative of a change in consciousness.

Brainwaves and related states of consciousness are said to be regulated by the brain's reticular formation stimulating the thalamus and cortex. This extended reticular-thalamic activation system (ERTAS) is implicated in a variety of functions associated with consciousness (Newman 1997). The word reticular means "net-like" and the neural reticular formation itself is a large, net-like diffuse area of the brainstem (Anch et al. 1988). The reticular activating system (RAS) interprets and reacts to *information* from internal stimuli, feelings, attitudes, and beliefs as well as external sensory stimuli by regulating arousal states, attentional focus, and the level of awareness – critical elements of consciousness itself (Empson 1986; Tice & Steinberg 1989). How we interpret, respond, and react to *information* then, is managed by the brain's reticular formation stimulating

the thalamus and cortex, and controlling attentiveness and level of arousal (Empson 1986). "It would seem that the basic mechanisms underlying consciousness are closely bound up with the brainstem reticular system . . ." (Henry 1992). In the ERTAS model, binaural beats engender changes in rhythmic EEG patterns throughout the cortex and our first-person experience of consciousness as cortico-thalamic projections adapt to *information* (the binaural-beat waveform) coming to the midbrain reticular formation.

Binaural beats were discovered in 1839 by a German experimenter, H. W. Dove. The human ability to "hear" binaural beats appears to be the result of evolutionary adaptation. Binaural beats can be detected by humans when carrier tones are below approximately 1000 Hz (Oster 1973). The sensation of "hearing" binaural beats occurs when two coherent sounds of nearly similar frequencies (the carrier tones) are presented, one to each ear, and the brain detects phase differences between these sounds. This phase difference normally provides directional information to the listener but when presented with stereo headphones or speakers the brain integrates the two signals, producing a sensation of a third sound called the binaural beat. Perceived binaural beating appears to originate in the brainstem's superior olivary nucleus, the site of contralateral integration of auditory input (Oster 1973). This auditory sensation is neurologically routed to the reticular formation (Swann et al. 1982) and simultaneously volume conducted to the cortex where it can be objectively measured as a frequency-following response (Oster 1973; Smith, Marsh, & Brown 1975; Marsh, Brown & Smith 1975; Smith et al. 1978; Hink et al. 1980). The objectively measured frequency-following response provides proof that the sensation of binaural beating has neurological efficacy.

Applications

Group interaction, counseling, guided visual imagery, affirmation, introspection, reframing, and goal orientation are all safe and effective methods of modifying an individual's social-psychological conditioning and limiting belief systems. Within the ERTAS model, projections between the pre-frontal cortex and the medial dorsal nucleus as well as collateral interaction with the nucleus reticularis (Newman 1997) allow for a change in social-psychological conditioning to not only directly alter the *content* of consciousness but also alter the *arousal level* associated with such content.

Cognitive skills can be enhanced through educational programs such as directed reading, lectures, multimedia presentations, planned group discussions, etc. Equipped with a greater cognitive acumen, individuals are capable of experiencing expanded points of view, i.e., new thoughts, unique ideas, wide-ranging concepts (the *contents* of consciousness). Cortico-thalamic adaptation of these new perspectives results in the first-person experience of propitious states of consciousness.

Binaural beats can be easily generated at the low frequencies (< 30 Hz) that are characteristic of the EEG spectrum (Oster 1973; Atwater 1997). Binaural beats in the delta (1 to 4 Hz) and theta (4 to 8 Hz) ranges have been associated with reports of relaxed, meditative, and creative states (Hiew 1995), sensory integration (Morris 1990), and used as an aid to falling asleep (Wilson 1990; Rhodes 1993). Exposure to audio-guidance training using lower-frequency binaural beats in concert with cognitive therapy resulted in decreased depressive symptoms in alcoholic patients

(Waldkoetter & Sanders 1997). Binaural beats in the alpha frequencies (8 to 12 Hz) have increased alpha brainwaves (Foster 1990) and binaural beats in the beta frequencies (typically 16 to 24 Hz) have been associated with reports of increased concentration or alertness (Monroe 1985), improved memory (Kennerly 1994), and increases in focused attention in mentally retarded adults (Guilfoyle & Carbone 1996).

The reported uses of this binaural-beat method for accessing propitious states of consciousness range from relaxation, meditation, stress reduction, pain management, health care (Carter 1993), and enriched learning environments to enhanced intuition, remote viewing (McMoneagle 1993), telepathy, and out-of-body experience. The effectiveness of binaural beats in engendering state changes is supported by the consistent reports of thousands of users, as well as the documentation of physiological changes associated with its use.

In objective, measurable terms EEG-based research provides evidence of binaural beat's influence on consciousness. Since the RAS regulates cortical EEG (Swann et al. 1982), monitoring EEG chronicles performance of the RAS. There have been several free-running EEG studies (Foster 1990; Sadigh 1990; Hiew 1995, among others) which suggest that binaural beating induces alterations in EEG. Because the RAS is responsible for regulating EEG (Swann et al. 1982; Empson 1986), these studies document measurable changes in RAS function during exposure to binaural beats.

Summary

The binaural-beat technology used in conjunction with a multidimensional approach of social-psychological conditioning and education provides access to many beneficial first-person experiences of consciousness. This safe and effective binaural-beat process offers a wide variety of applications which include, but are not limited to: relaxation, meditation, enhanced creativity, intuition development, enriched learning, improved sleep, wellness, and the personal exploration of expanded states of consciousness.

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